

Aerial Deposition and its Relevance to TMDLs in the City of San Diego

Dave Renfrew, CPSWQ, REA-I

***California Non Point Source
Conference 2008***



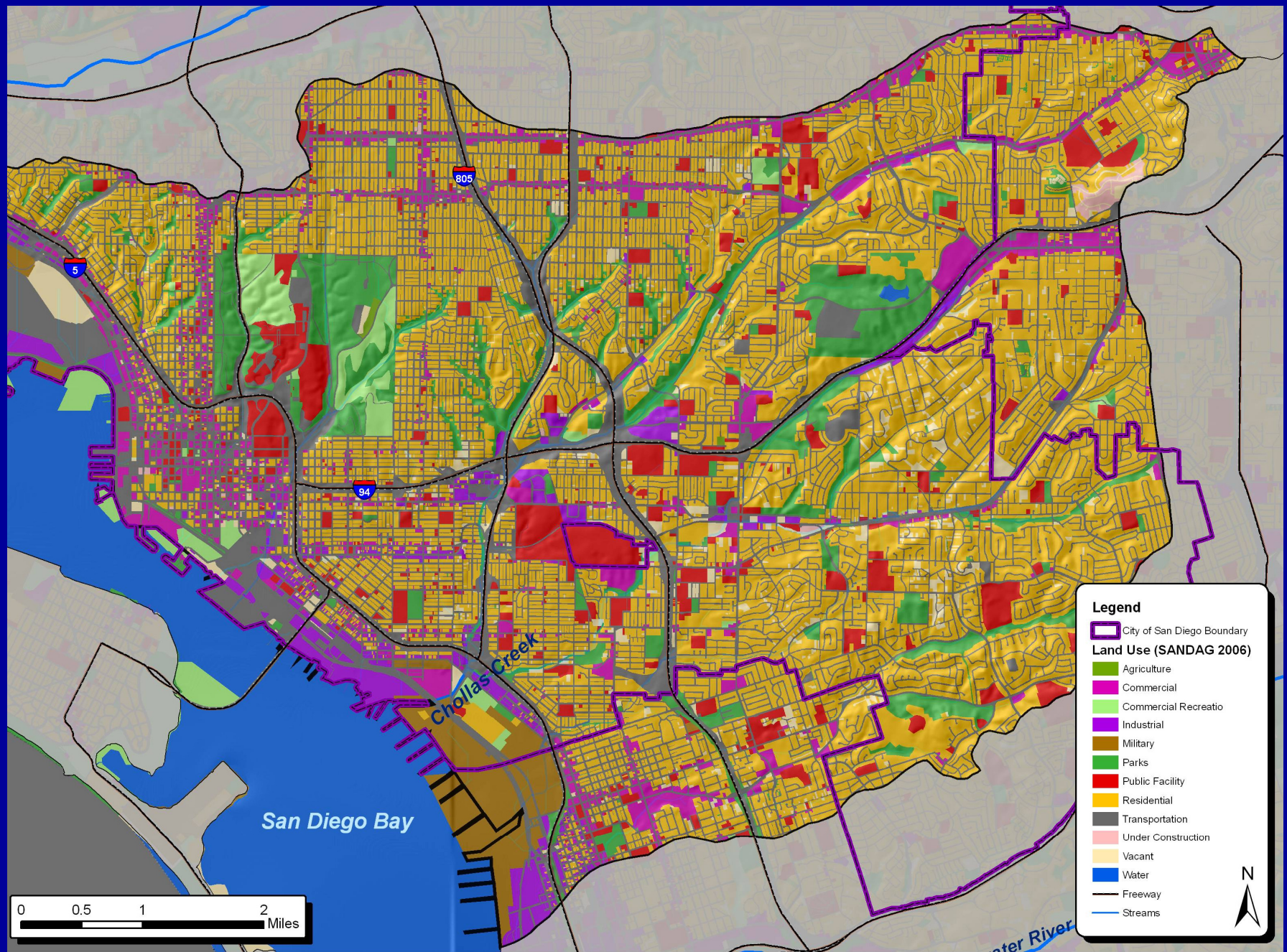
America's Finest City

THE CITY OF SAN DIEGO



Background

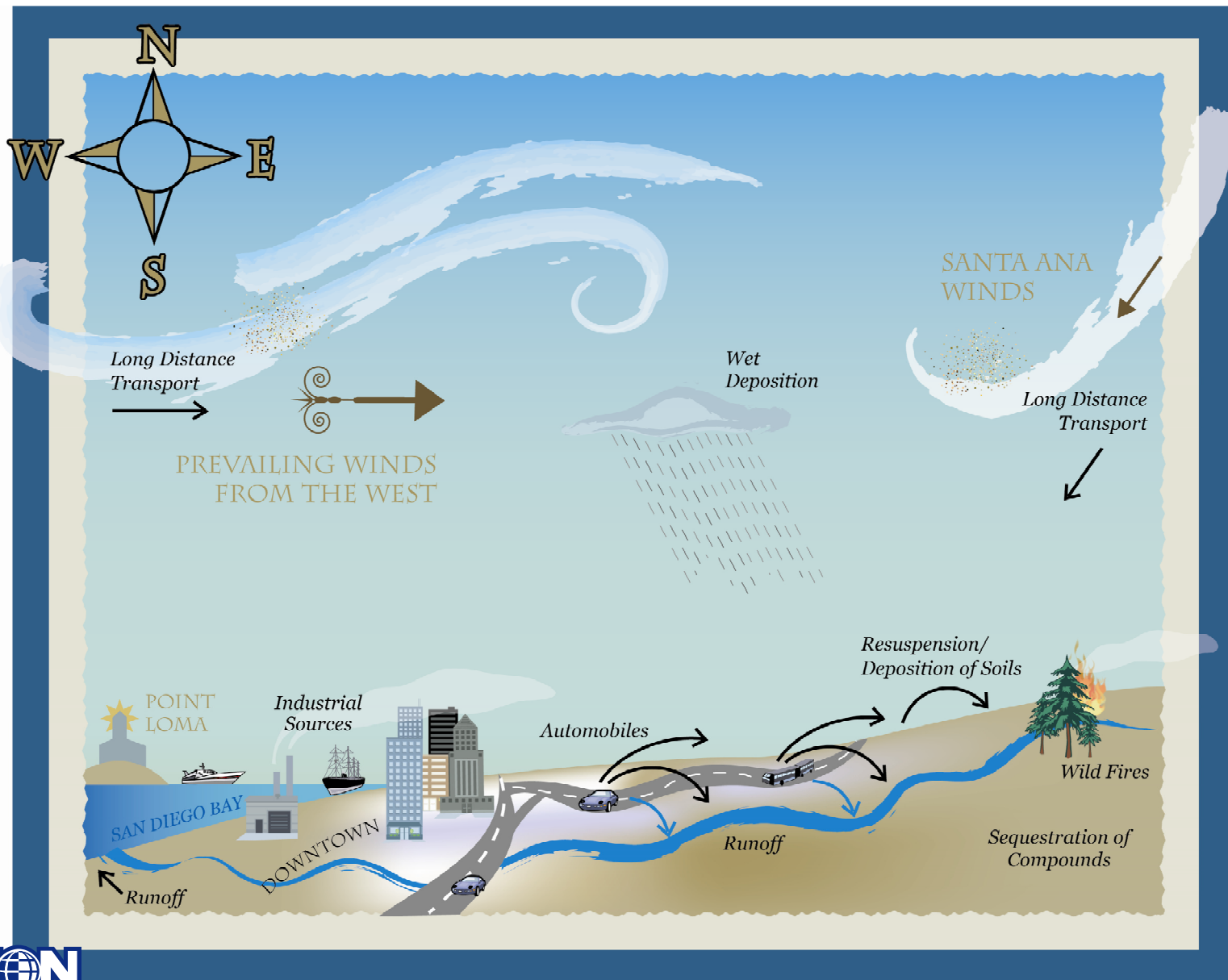
- Chollas Creek Metals TMDLs
 - Dissolved-Cu, Pb, Zn
 - CTR basis
- 303 (d) Listings Tecolote Creek, Mission Bay, Mouth of Chollas, Switzer, and Paleta Creeks (future TMDLs for Cu, Pb, Zn, and others)
- RWQCB acknowledged aerial deposition as a factor influencing Chollas Creek metals concentrations but to an unknown degree (source is the MS4)



Unknown Sources

- Metals are ubiquitous in the Chollas Watershed
- IC/ID typically inconclusive for metals.
- Air deposition studies have been a focus in SF and LA, but not in the SD Region.
- Study by Sabin, et al., 2005 attributed 57-100% of the metals in SW due to atmospheric deposition.

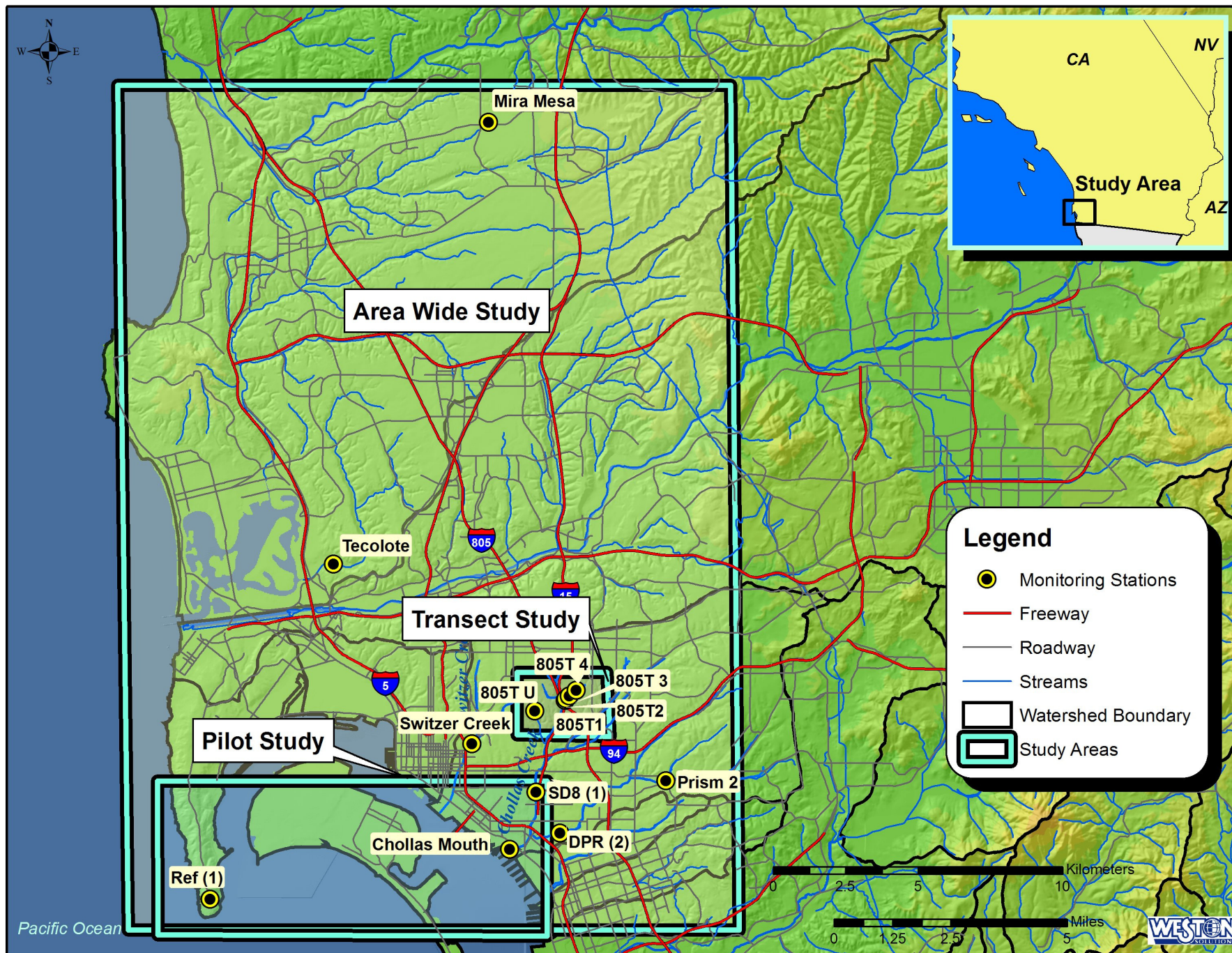
Deposition Rate = air concentration x deposition velocity

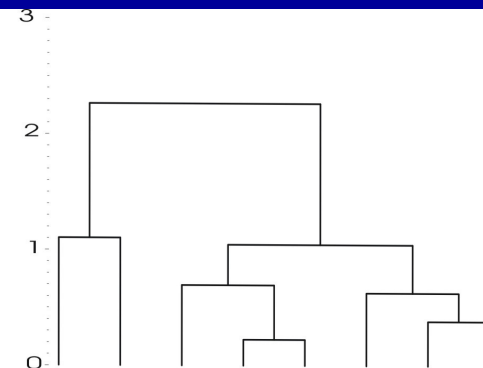
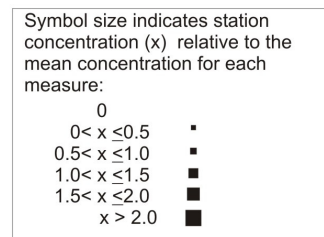
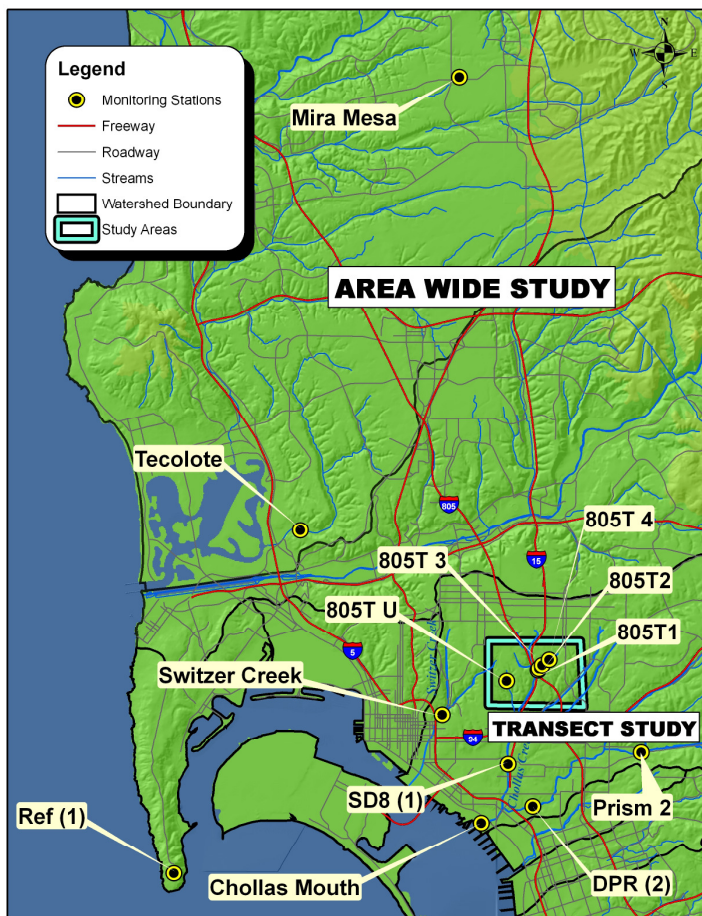


Aerial Deposition Study Design

- How Much Loading?
- Where (is it a regional problem or local)?
- Characteristics?
 - (Focus on Cu, Pb, and Zn)
- Why?
- What is the link to WQ?







Distance between clusters

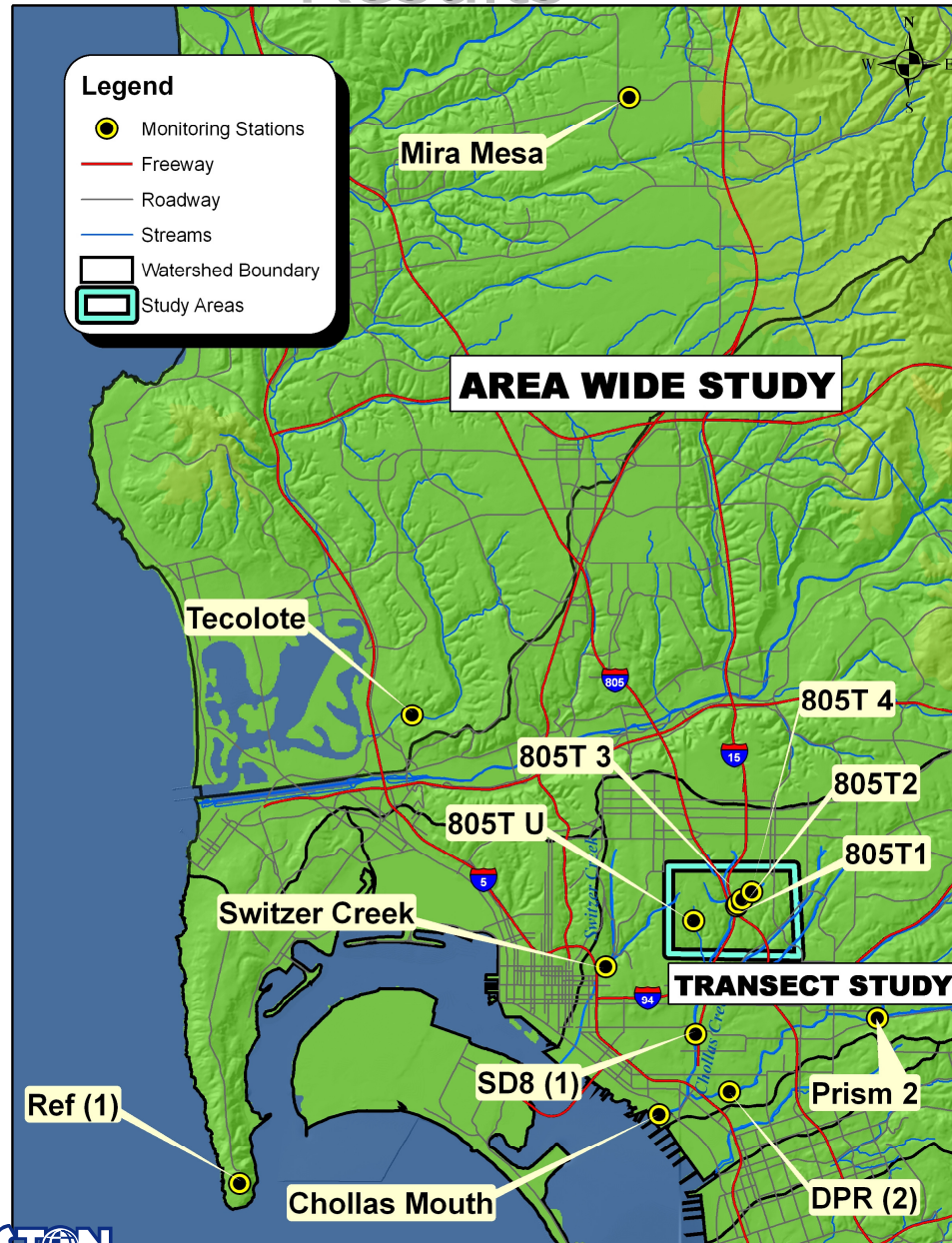
	Chollas Mouth	Ref (1)	Switzer Creek	DPR 2	SD8(1)	Mira Mesa	Prism 2	Tecolote
Water	■	■	■	■	■	■	■	■
Industrial	■	■	■	■	■	■	■	■
Freeways	■	■	■	■	■	■	■	■
Low Density Residential	■	■	■	■	■	■	■	■
Transportation	■	■	■	■	■	■	■	■
High Density Residential	■	■	■	■	■	■	■	■
Open Space and Parks	■	■	■	■	■	■	■	■
Commercial	■	■	■	■	■	■	■	■

Methods

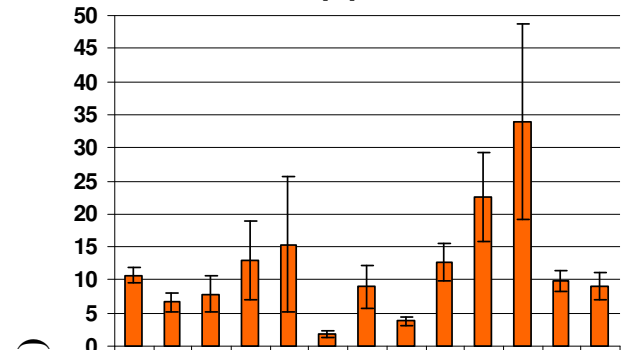
- Deposition Measurements

- Dry Deposition – surrogate surface with aerodynamic leading knife edge
- 8 monitoring events over 4 months (prior to 1st storm)
- XRF analysis using EPA Compendium Method IO-3.3 (37 elements + net mass)
- Photomicrography
- Particle size distribution
- SEM/EDX to identify target elements on specific particles
- Wind Data

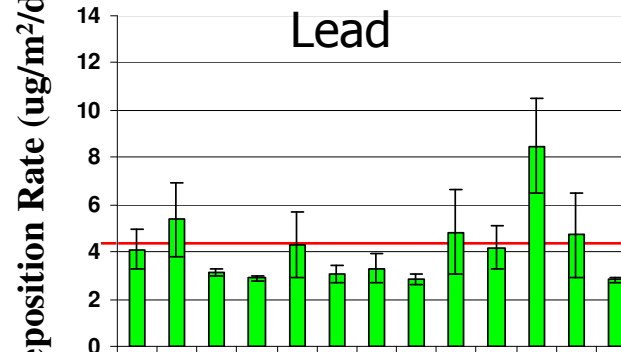
Results



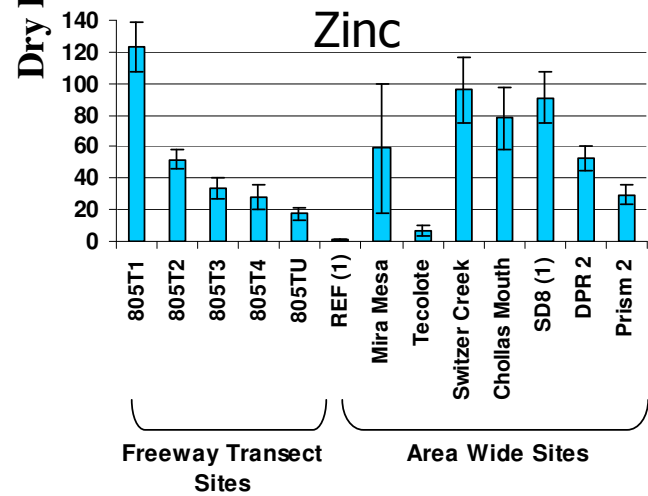
Copper



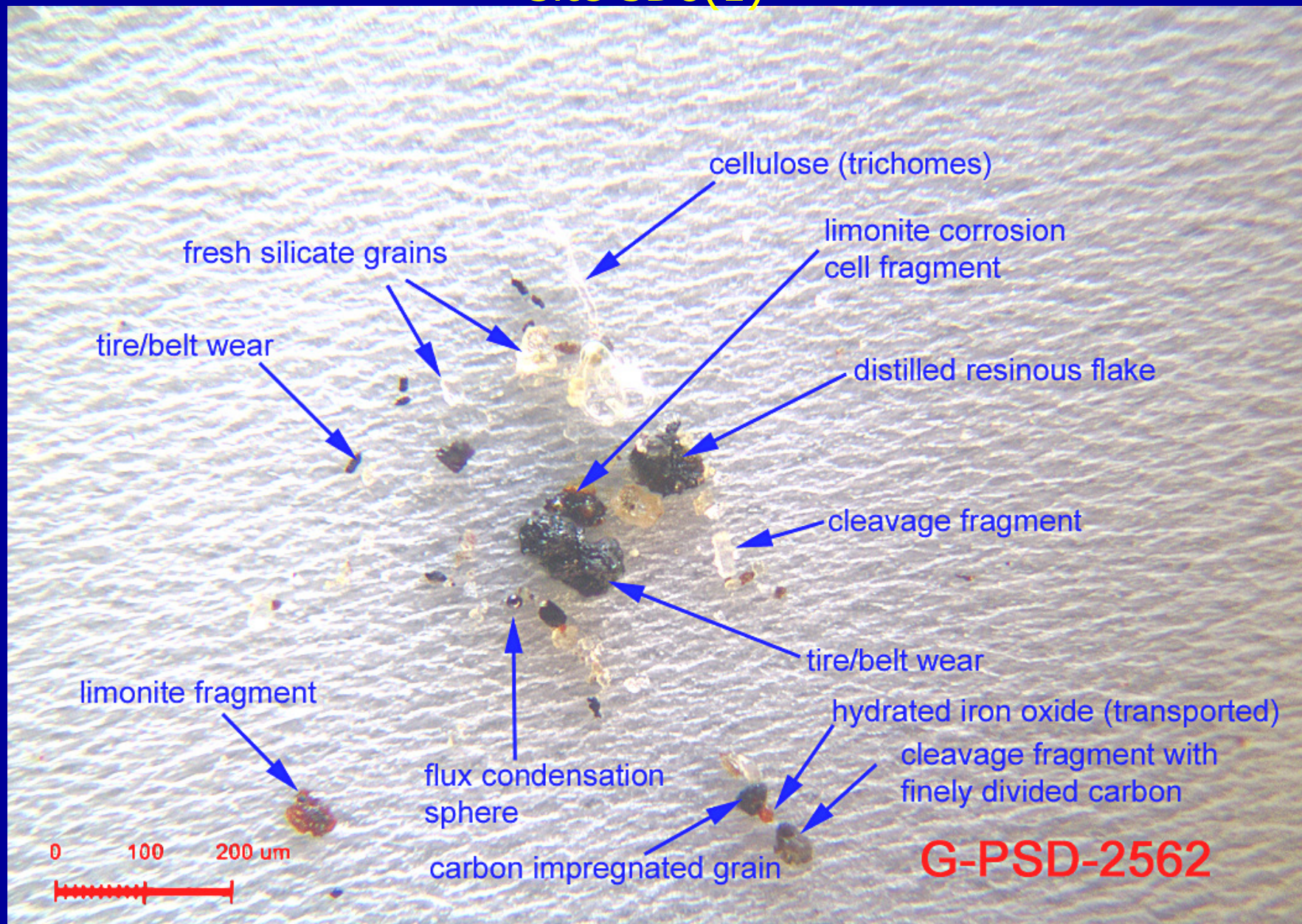
Lead



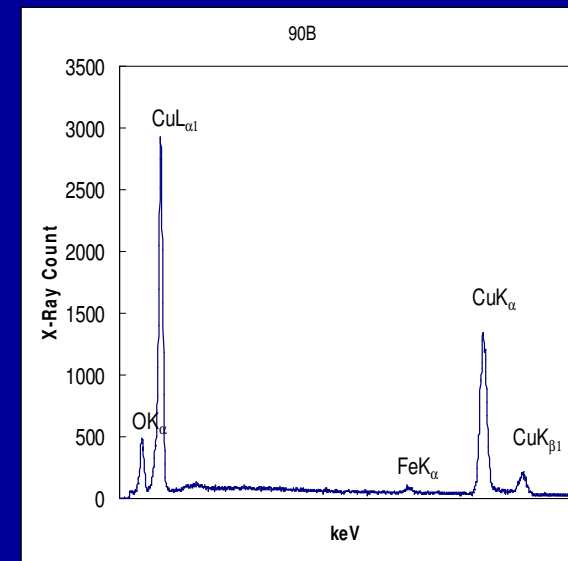
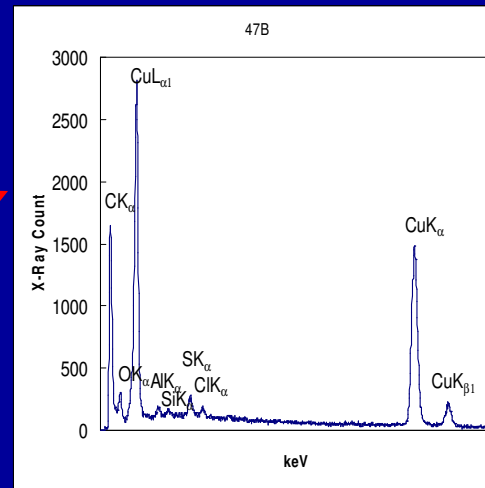
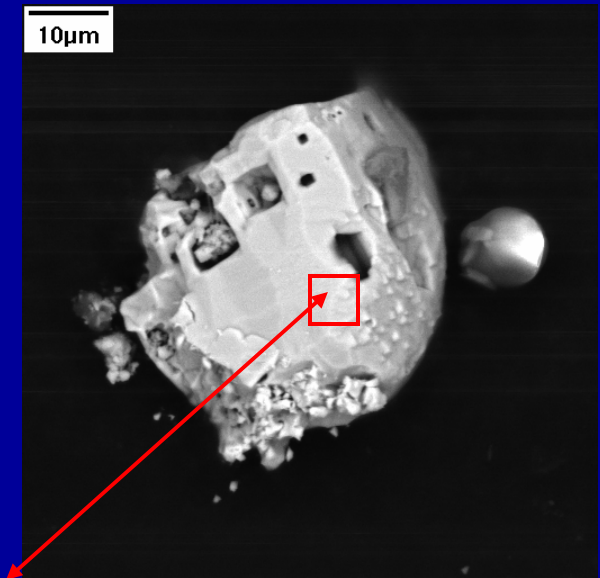
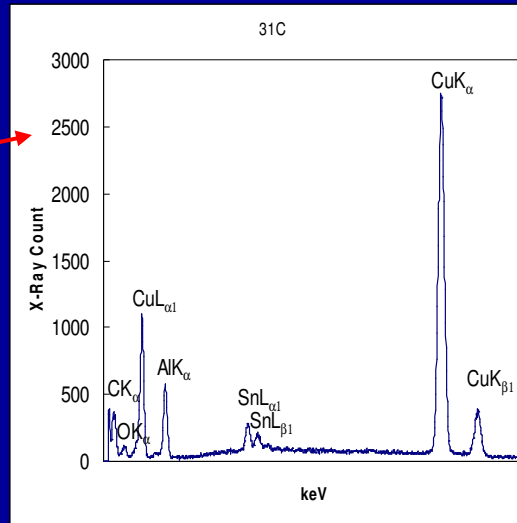
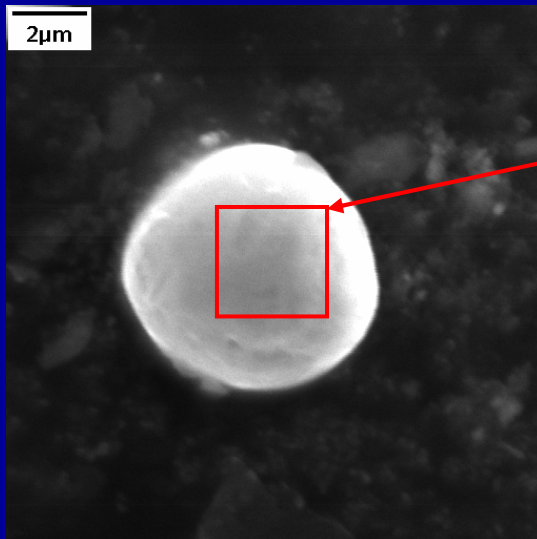
Zinc



Site SD8(1)



Copper



Air Dispersion Modeling

- Industrial Source Complex Short Term Version 3 (ISCST3)
 - Freeways
 - High-Traffic Local Roads
 - Low-Traffic Local Roads
- Emissions developed using ARB (EMFAC) and EPA (AP-42 Paved Roadways) Methods
- Four Source Types and Four Particle Sizes
 - Re-entrained roadway dust, brake wear, tire wear, and exhaust.
 - PM_{15-30} , PM_{10-15} , $PM_{2.5-10}$, $<PM_{2.5}$

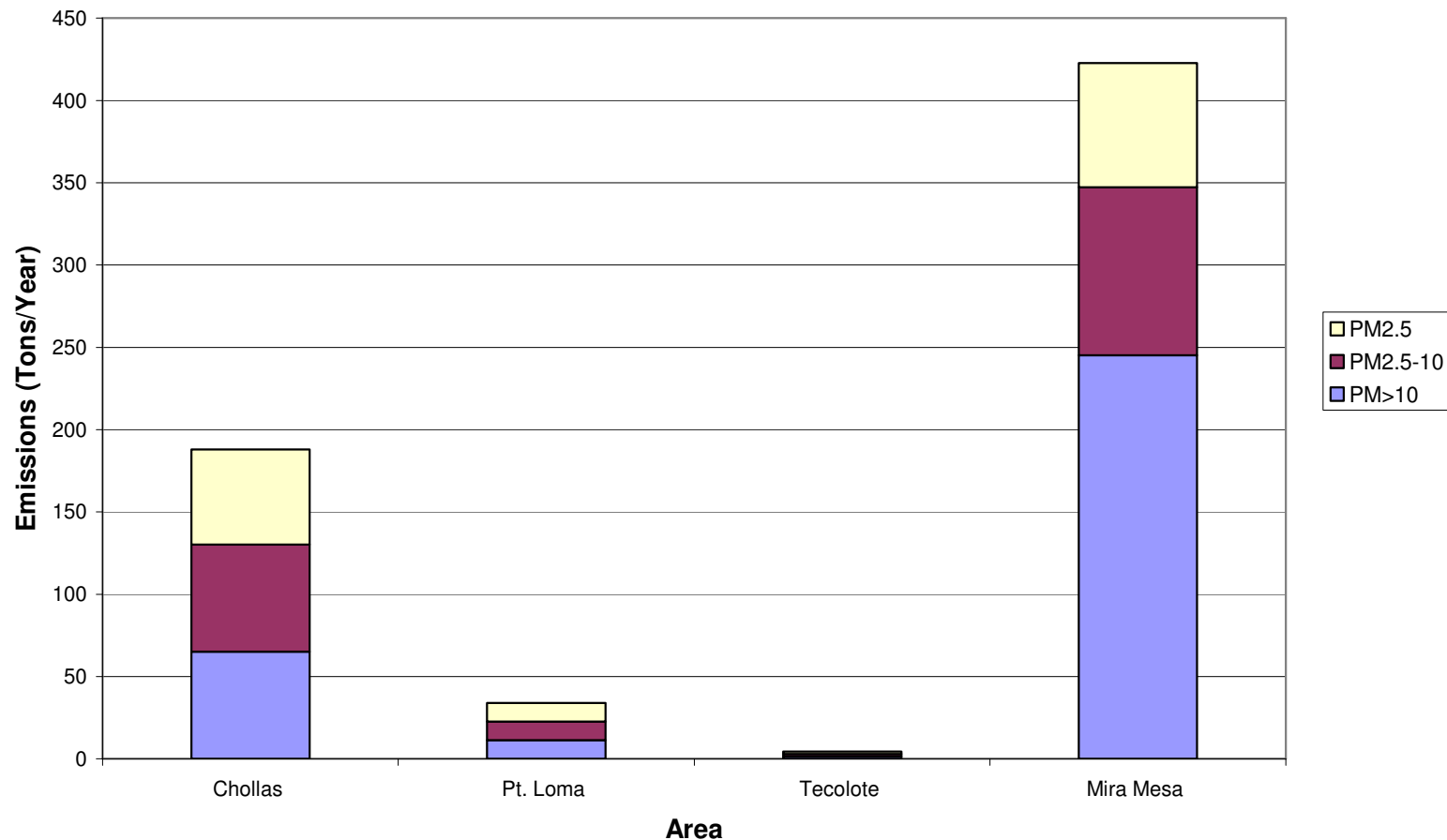
Air Dispersion Modeling

Roadway Type	Modeled Emissions (g/day)				Modeled Length (mi)	Daily Vehicles
	Exhaust	Tire Wear	Brake Wear	Re-entrained Dust		
Freeway	401.4	190.1	274.6	27,929.4	0.124	170,000
Commercial	114.8	49.2	71.1	10,487.8	0.099	55,000
Residential	1.9	0.6	0.9	571.5	0.099	700

Size Range	Portion of Total Mass Emitted in Size Fraction (%)					
	Re-entrained Dust			Vehicular Sources		
	Freeway	Commercial	Residential	Freeway	Commercial	Residential
PM ₁₅₋₃₀	78.7%	78.1%	76.8%	0.0%	0.0%	2.0%
PM ₁₀₋₁₅	4.6%	4.5%	4.5%	0.0%	0.0%	0.0%
PM _{2.5-10}	13.7%	13.9%	14.4%	40.9%	39.0%	33.5%
PM _{2.5}	3.0%	3.5%	4.4%	59.1%	61.0%	64.5%

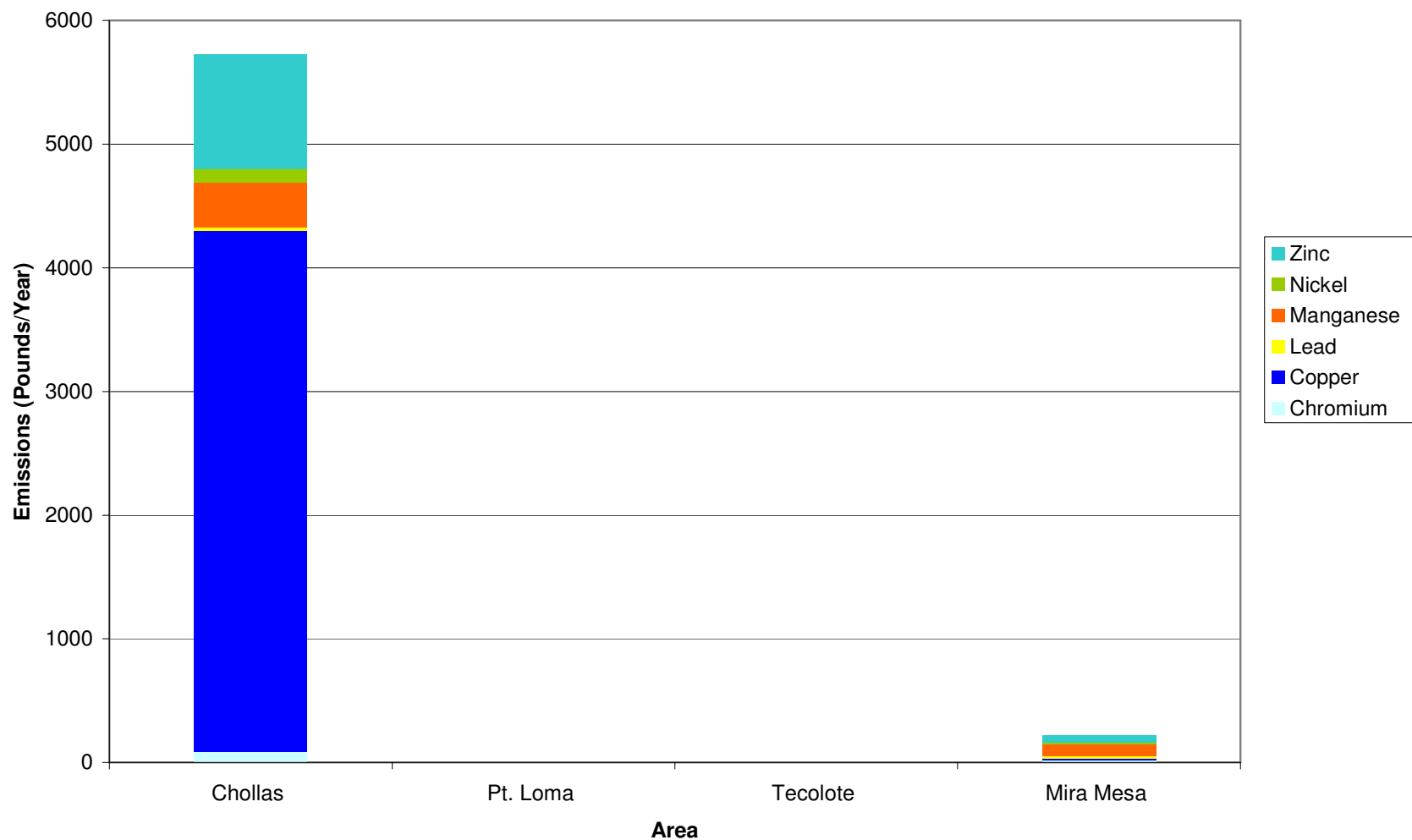
San Diego Industrial Emissions

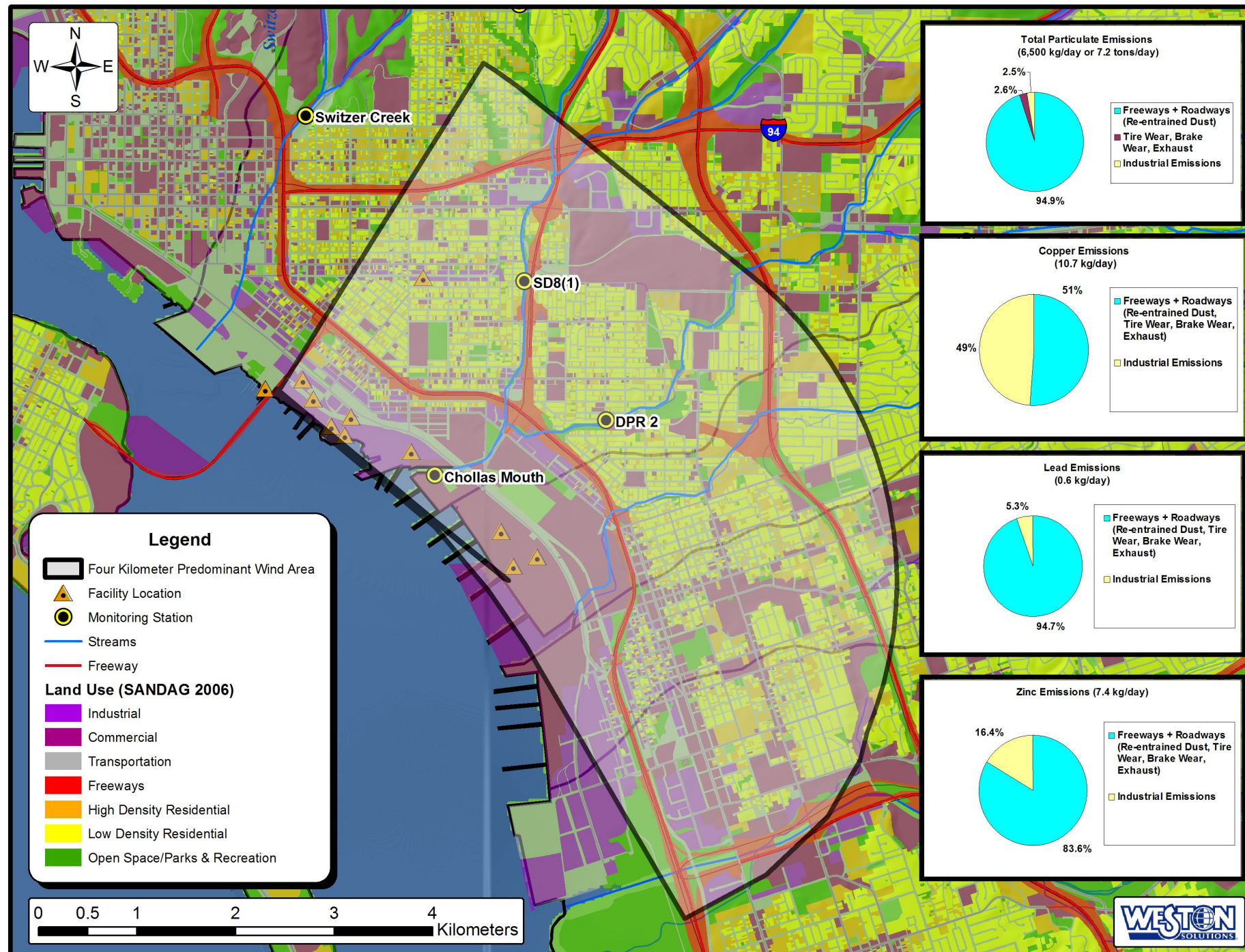
Particulates (tons/yr) Reported to ARB



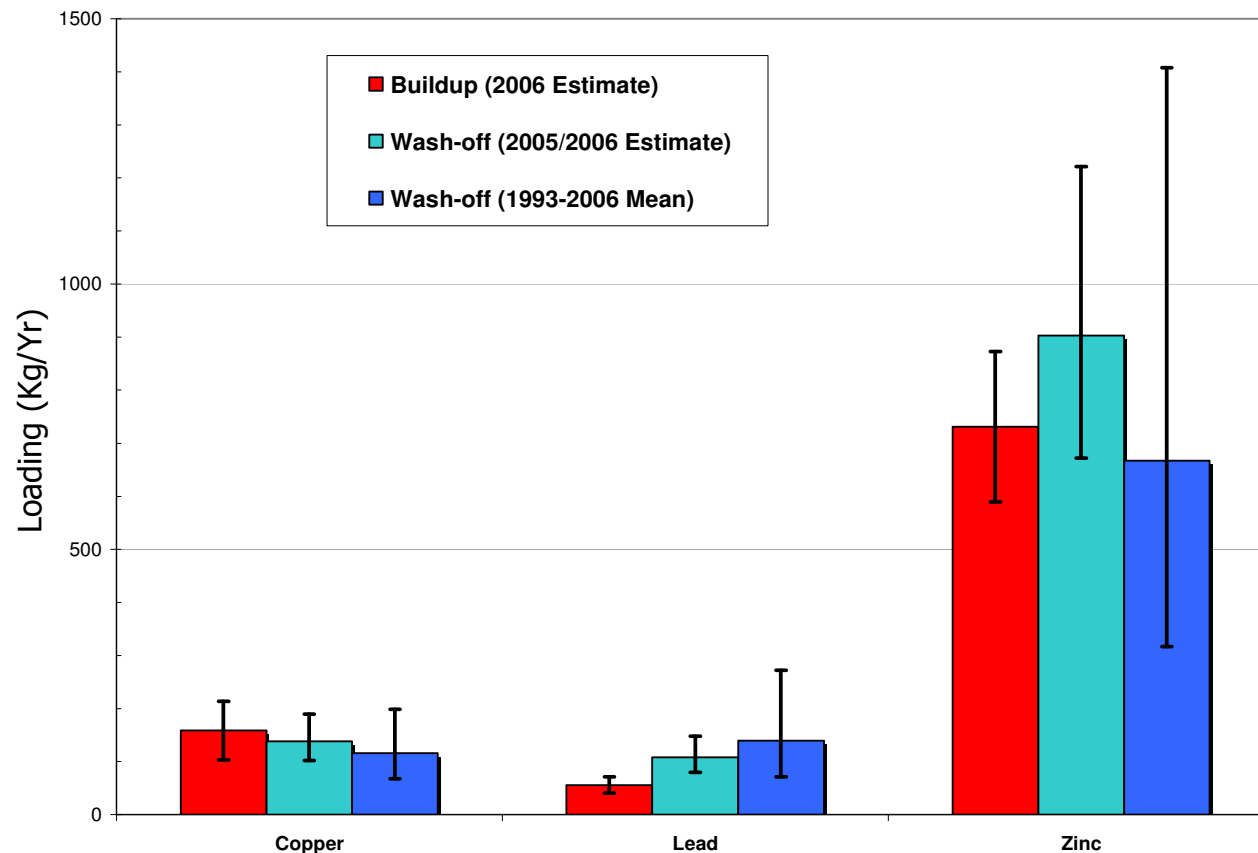
San Diego Industrial Emissions

Metals (pounds/yr) Reported to ARB



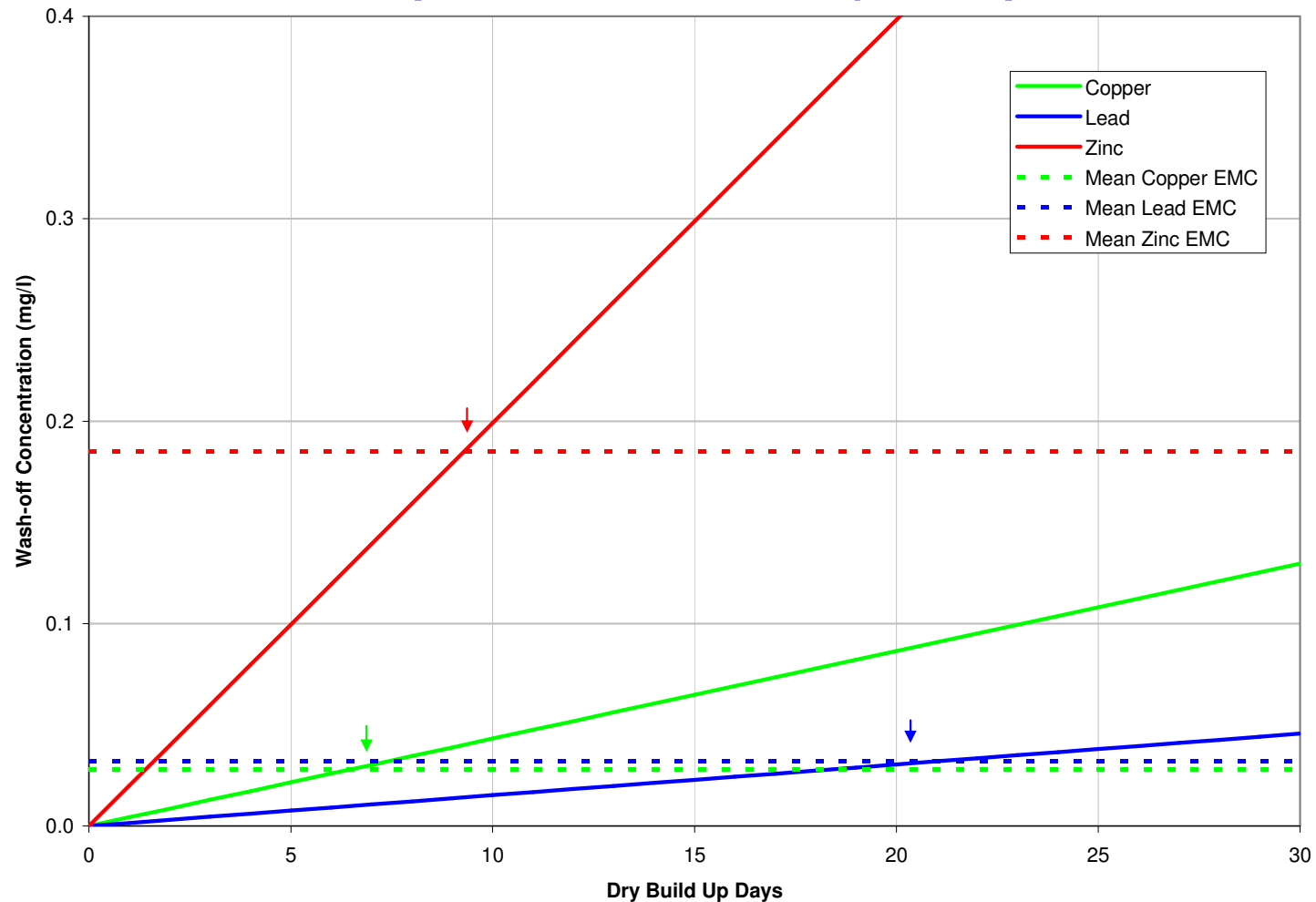


Water Quality Modeling Results



Estimate of Washoff Concentration at SD8(1)

(based on build up rate)



Source Assessment

- Copper is likely a function of brake wear debris regionally
 - unregulated industrial emissions may also dominate in the lower watershed area of Chollas Creek.
- Zinc is primarily a function of tire/belt wear near major roadways.
 - Galvanized wear debris observed.
 - Industrial component may contribute in the lower watershed area of Chollas Creek.
- Lead was likely attributable to resuspended dust (legacy gasoline, paint chips)



Implications

- Copper not likely controlled until sources are reduced or eliminated.
- Zinc is likely a function of tire wear, primarily in the coarse particle mode. This may be reduced with physical separation techniques and street sweeping.
- Lead may be controlled by identifying soils with elevated concentrations, and by reducing soil erosion.
- Street sweeping may be needed at a more frequent rate to reduce the effects of resuspended dust.
- Air dispersion modeling demonstrated street sweeping more likely to be effective if focused on freeways and commercial roadways as opposed to residential areas (for metals).

Recommendations

- SWRCB and EPA involvement needed to interface with ARB to control emissions.
- Participation/involvement with the Brake Pad Partnership. (Ongoing)
- Request storm water agencies to continue to pursue air quality regulatory changes to address WQ impacts.
- Perform outreach to industries that may emit significant metals concentrations.
- Ordinances, public outreach, train inspectors to look for evidence of significant emissions. (Ongoing)

Current Studies

- Conducting an annual assessment of dry deposition loads.
- Evaluating the solubility of aerially deposited particles.
 - Similar results to BPP findings on wear debris.
 - pH is the driver
- Evaluation of wet deposition contribution during storm events.

Thank You!

David S. Renfrew, CPSWQ, REA-I
Weston Solutions, Inc.

2433 Impala Drive
Carlsbad, CA 92010
760-795-6903 (direct)
760-908-5749 (cell)

dave.renfrew@westonsolutions.com



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